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This document establishes procedures and methods for determining the physical characteristics of aviation materiel undergoing technical testing. These procedures cover techniques for obtaining physical characteristics data for aircraft (both fixed and rotary wing), avionics, electronics and communications equipment; aircraft subsystems and associated equipment; ground support equipment; and personnel equipment. Other tests required will be performed in accordance with the appropriate common Test Operations Procedures (TOP).

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U.S. ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

AMSTE-RP 702-106

*Test Operations Procedure (TOP) 7-3-500
AD NO.



TO May 1991

PHYSICAL CHARACTERISTICS
(AVIATION MATERIEL)

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1. SCOPE. This document establishes procedures and methods for determining the physical characteristics of aviation materiel undergoing developmental testing. These procedures cover techniques for obtaining physical

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characteristics data for aircraft (both fixed and rotary wing); avionics, electronics and communications equipment; aircraft subsystems and associated equipment; ground support equipment; and personnel equipment. Other tests required will be performed in accordance with the appropriate common Test Operations Procedures (TOP).

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities. Most aviation materiel tested under these procedures either has to be installed in (or on) an aircraft or is used in direct support of an aircraft. Therefore, a typical Army airfield installation with appropriate maintenance hangar and shop facilities will usually be needed to support the test item.

<u>ITEM</u>	<u>REQUIREMENTS</u>
Calibration shop	Capable of calibrating maintenance tools and test equipment furnished to support the test item
Comparison items	As required
Materiel handling equipment	As required
Standard tool sets	Aviation unit and intermediate maintenance levels authorized to support the test item
Special-purpose test sets	As specified in technical manuals for adjustments, repairs, alignment, and other maintenance of the test item

2.2 Instrumentation.

<u>DEVICES FOR MEASURING</u>	<u>PERMISSIBLE ERROR OF MEASUREMENT*</u>
Length, width, etc. (e.g., measuring tapes in centimeters and inches)	±0.5%

* The permissible error of measurement for instrumentation is the two-sigma value for normal distribution; thus, the stated errors should not be exceeded in more than one measurement out of 20.

Fine metric dimensions (e.g., calipers, including vernier; micrometers; dividers; steel squares)	$\pm 0.1\%$
Weight (e.g., scales)	$\pm 0.25\%$
Volume (liquid, particle containers)	5%

3. REQUIRED TEST CONDITIONS.

3.1 Facilities. The test facilities needed to support the test item should be in normal operating condition. Testing will normally be conducted at an established facility, one that needs only minimal preparation or setup time. When testing is to be conducted at a location where the needed equipment and facilities will not be available, they must be obtained through coordination with appropriate agencies.

3.2 Equipment (Test Item). The test director/engineer shall ensure that:

a. Qualified personnel are used to perform the technical portions of the test.

b. The overall training and familiarization procedures on the equipment being tested include the following:

(1) Documentation using the following items:

(a)³ Applicable requirements of MIL-STD-129L,¹ MIL-STD-130G,² and FED-STD-751A.

(b) System Support Package inventory list.

(c) Basic issue item list (BIIL).

(d) Draft technical manuals.

(2) Equipment and procedures.

(3) Measuring and weighing techniques for aircraft, subsystems, equipment and clothing (as required).

(4) Photographic requirements and data requirements.

¹Reference numbers/letters match those in appendix C, References.

3.3 Instrumentation. Plan for the use of photography whenever possible to illustrate findings and results of tests.

3.4 Data Required. Prepare record forms for the systematic entry of data, the chronology of tests, and the physical characteristics of the test items.

4. TEST PROCEDURES. Use the appropriate procedure for the category of equipment being tested.

4.1 Fixed-wing Aircraft Exterior Measurements.

a. Method.

- (1) Tires should be inflated to recommended pressures.
- (2) Situate the aircraft on a smooth, level surface.
- (3) Obtain the measurements indicated in paragraph 1, appendix B, with aircraft's flight controls centered or positioned as recommended by the operator's manual.
- (4) For maximum height and minimum ground clearance dimensions, measure alternately with the aircraft configured for ferry and combat missions, with applicable minimum and maximum gross takeoff weights for each configuration.

b. Data required. All data will be collected to coincide with test methods and data collection forms in appendix B.

4.2 Rotary-wing Aircraft Exterior Measurements.

a. Method.

- (1) Inflate tires, as applicable, to operating pressure recommended by the maintenance manual for each operational configuration. Measure rotor system and correlate the dynamic dimensions of the moving rotor system.
- (2) Situate the helicopter on a smooth, level surface. Obtain the measurements indicated in paragraph 2, appendix B, with the helicopter's cyclic stick, directional pedals, and other controls in the position recommended by the operator's manual (usually neutral) and in other positions which will result in minimum ground clearance dimensions and the maximum overall length, width, and turning-radii dimensions.

(3) Configure the aircraft alternately for ferry and combat missions, with minimum and maximum gross takeoff weights applicable for each configuration.

b. Data required. All data will be collected to coincide with test methods and data collection forms in appendix B.

4.3 Interior Measurements.

a. Method. Obtain the measurements indicated in paragraph 3, appendix B, for both fixed and rotary-wing aircraft.

b. Data required. All data will be collected to coincide with test methods and data collection forms in appendix B.

4.4 Aircraft Weight and Center of Gravity.

a. Method.

(1) Weigh the aircraft in accordance with approved procedures.

(2) Determine the data contained in paragraph 4, appendix B.

(3) Photograph to the extent necessary to illustrate adequately the measurements taken and to document specific features of the aircraft.

b. Data required. All data will be collected to coincide with test methods and data collection forms in appendix B.

4.5 Aircraft Subsystems and Associated Equipment.

a. Method.

(1) Weigh and measure each major component with or without expendables, as applicable.

(2) Determine the data contained in paragraph 5, appendix B.

(3) Volumes.

(a) Regularly shaped components: Compute the volumes by means of the linear measurements taken in accordance with paragraph 4.5a(1), above.

(b) Irregularly shaped components:

- If the component is immersion-proof, measure its volume by the liquid displacement method.

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- If the component is not immersion-proof, use the dry particle displacement method. The size and type particle will be chosen to provide necessary accuracy for the component to be measured.

b. Data required. All data will be collected to coincide with test methods and data collection forms in appendix B.

4.6 Electronic, Avionics, and Communication Equipment.

a. Method.

(1) Measure and photograph, as appropriate, each individual component and the completely assembled and/or installed test item.

(2) Indicate maximum dimensions where peripheral objects extend beyond the envelope of major dimensions; e.g., switches, handles, knobs, and chassis-locking fasteners.

(3) Weigh each unit including attachments such as knobs, dials, switches, and plug mounts; exclude associated cables and connectors.

b. Data required. All data will be collected to coincide with test methods and data collection forms in appendix B.

4.7 Ground Support Equipment.

4.7.1 Vehicles and Carts.

a. Method.

(1) Weigh and measure the test item to provide the data described in paragraph 7a, appendix B, including internal measurements, and empty and full or operating weights.

(2) Photograph the item to illustrate the physical characteristics, as appropriate.

b. Data required. All data will be collected to coincide with test methods and data collection forms in appendix B.

4.7.2 Test Sets.

a. Method.

(1) Measure and weigh the test item prepared for service and configured for storage.

(2) Record the principal dimensions and weights of the equipment as outlined in paragraph 7b, appendix B.

b. Data required. All data will be collected to coincide with test methods and data collection forms in appendix B.

4.8 Personnel Equipment.

4.8.1 Clothing (Protective and Flight). (See TOPs 7-2-087^a, 7-3-087^b, 7-3-095^c, 7-3-509^d, and 7-3-529^e.)

a. Method.

(1) Measure across the breast area of the clothing from side seam to side seam, at the bottom of the armholes.

(2) Measure the sleeve length along the sleeve inseam from the base of the armhole to the bottom of the sleeve cuff.

(3) Measure the trouser inseam from the center of the crotch to the bottom of the leg.

(4) Measure the waist at the belt line.

(5) Match the clothing fabric/material with a sample of the shade specified in the requirements documents under artificial daylight, having a color temperature of 5,200° K, to determine if the desired color match was achieved.

(6) Identify the clothing stitches and seam types by classification in accordance with requirements document, FED-STD-751A.

(7) Weigh the complete protective and flight clothing.

(8) Correlate the stated size with the measured data obtained.

b. Data required. All data will be collected to coincide with test methods and data collection forms in appendix B.

4.8.2 Helmets. (See TOPs 7-3-085^f, 7-3-509, and 7-3-529.)

a. Method.

(1) Measure the inner and outer diameter of the helmets, the maximum and minimum length of the chin strap, the communication cable length and type of connector(s), and the visor dimensions.

(2) Record visor lens type; e.g., clear, neutral gray, or gold coated, and weigh the helmet with and without communications accessories.

(3) Determine, by trial fitting on head-forms of various standard sizes, the range of head sizes that the helmet will accommodate.

b. Data required. All data will be collected to coincide with test methods and data collection forms in appendix B.

4.8.3 Ammunition.

a. Method.

(1) Photograph representative ammunition items from received lots.

(2) Determine the lot number, composition of projectile and payload, as appropriate, and round length, maximum and minimum diameter and weight.

b. Data required. All data will be collected to coincide with test methods and data collection forms in appendix B.

5. PRESENTATION OF DATA.

a. The test results will be presented in tables, charts, graphs, and photographs, as required to present results clearly and accurately.

b. The physical characteristics will be compared against those specified in the requirements documents to determine whether the criteria were met or not met.

c. The test results will be reviewed and analyzed to classify incidents as significant problems requiring corrective action, suggested improvements, or no action required.

d. Supporting rationale will be provided for classifying incidents as significant problems requiring corrective action.

e. For all significant problems and all failures to meet the criteria, assessment of the impact on the operational capability of the test item will be included.

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Forward comments, recommended changes, or any pertinent data which may be of use in improving this publication to Commander, U.S. Army Test and Evaluation Command, ATTN: AMSTE-TC-D, Aberdeen Proving Ground, MD 21005-5055. Technical information may be obtained from the preparing activity: Commander, U.S. Army Aviation Technical Test Center, ATTN: STEAT-MP-P, Fort Rucker, AL 36362-5276. Additional copies are available from the Defense Technical Information Center, Cameron Station, Alexandria, VA 22304-6145. This document is identified by the accession number (AD No.) printed on the first page.

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APPENDIX A

CHECKLIST

PHYSICAL CHARACTERISTICS (AVIATION MATERIEL)

YES

NO

1. Is the test item in condition for testing?
2. Has the system been serviced and maintenance forms completed?
3. Have pre-operational check (if required) been accomplished?
4. Has all instrumentation, measuring, and weighing equipment been calibrated?
5. Have all data been collected in accordance with the provisions of this TOP?
6. Have all appropriate data forms in Appendix B been completed?
7. Have all data forms been reviewed for correctness and completeness?
8. Have all data been prepared for inclusion in the final test report?
9. Has testing been completed in accordance with TOP 7-3-500?

APPENDIX B
DATA COLLECTION FORMS

1. Fixed-wing Aircraft Exterior Measurements.

a. Wing span (meters(m)/feet(ft))	<u>14.8/48.5</u>
b. Overall length (m/ft).	<u>14.1/46.2</u>
c. Maximum fuselage length (m/ft).	<u>13.9/45.7</u>
d. Maximum fuselage width (m/ft).	<u>1.9/ 6.2</u>
e. Height of highest point of rudder structure (m/ft).	
Ferry gross takeoff weight.	<u>6.1/20.1</u>
Combat mission takeoff weight.	<u>6.0/19.8</u>
f. Height of propeller tips when placed in vertical position (ferry and combat missions configuration gross takeoff weights) (m/ft).	<u>4.8/15.7</u>
g. Propeller swept circle diameter (m/ft).	<u>3.1/10.0</u>
h. Ground clearance (centimeters(cm)/inches(in)).	
	<u>Mission</u>
	<u>Ferry</u> <u>Combat</u>
(1) Propeller.	<u>68.6/27.0</u> <u>63.5/25.0</u>
(2) Wing tip.	<u>182.9/72.0</u> <u>174.7/68.8</u>
(3) Horizontal stabilizer tip.	<u>190.7/75.1</u> <u>185.2/72.9</u>
i. Minimum turning radii (m/ft).	
(1) Wing tip.	<u>7.7/25.4</u>
(2) Horizontal stabilizer tip.	<u>7.0/23.2</u>
(3) Propeller tip (placed in horizontal position).	<u>3.9/12.7</u>

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j. Wheelbase (m/ft). 3.8/12.5

k. Tread width (m/ft). 2.1/ 7.0

2. Rotary-wing Aircraft Exterior Measurements.

a. Length (m/ft).

(1) Static. 15.2/49.7

(2) Dynamic. 15.2/49.9

(3) Flight controls in extreme positions. 15.2/49.8

b. Width (m/ft).

(1) Static. 12.2/40.2

(2) Dynamic. 12.3/40.4

(3) Flight controls in extreme positions. 12.3/40.5

c. Height.

	<u>Mission</u>	
	<u>Ferry</u>	<u>Combat</u>
Fuselage	<u>4.7/15.3</u>	<u>4.6/15.1</u>
Entrance (Measure to entrance lower edge. Repeat for as many entrances as exist for the aircraft type.)	<u>1.1/ 3.5</u>	<u>1.0/ 3.4</u>
Main Rotor System (Measure to topmost point of rotor system. Repeat for multi main rotor systems.)	<u>5.6/18.2</u>	<u>5.5/18.1</u>
Tail Rotor System (Measure to top of rotor blade with blade positioned in the vertical position to yield maximum height.)	<u>5.3/17.3</u>	<u>5.2/17.2</u>

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d. Ground clearances.

	<u>Mission</u>	
	<u>Ferry</u>	<u>Combat</u>
(1) Main rotor blade (m/ft) (Repeat for multi rotor systems. Measure distance between blade tip and ground with the blade rotated to lowest level, at front, right side, left side, and rear of aircraft.)		
Front	<u>2.4/ 8.0</u>	<u>3.0/10.0</u>
Right Side	<u>3.0/10.0</u>	<u>3.7/12.0</u>
Left Side	<u>3.0/10.0</u>	<u>3.7/12.0</u>
(2) Fuselage (cm/in) (Measure lowest point of the fuselage to ground.)	<u>71.1/28.0</u>	<u>74.9/29.5</u>
(3) Antenna (cm/in)		
Appendages on lower fuselage	<u>61.0/24.0</u>	<u>64.8/25.5</u>
e. Turning radii (m/ft).		
(1) Main rotor or forward rotor blade tip.		<u>11.9/39.2</u>
(2) Tail rotor or aft blade tip.		<u>10.8/35.6</u>
(3) Fuselage (Maximum extremity, specify locations of measurement.)		<u>10.4/34.2</u>
(4) Armament subsystem weapon launcher support station(s) (Maximum extremity, specify locations of measurement.)		<u>9.9/32.5</u>
f. Swept circle diameter (m/ft).		
(1) Main rotor or forward rotor.		<u>12.9/42.5</u>
(2) Tail or aft rotor		<u>3.1/10.2</u>

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g. Wheel/skid dimensions (m/ft).

(1) Wheel base or skid length 7.6/25.1

(2) Tread width or skid width 2.0/ 6.7

3. Interior Measurements.

a. Compartment and access door (cm/in or m/ft) (Repeat for each access door for avionics, baggage, inspection, etc. Specify access door on data form. Select units depending on door size.)

Height 60.9/24.0

Width 76.2/30.0

b. Cockpit and passenger cabin dimensions (m-cm/ft-in). 1.8/6.0

c. Floor plans indicating cargo tiedown locations, dimensions, and strength of each tiedown (by aircraft frame station). Drawing provided Yes/No

4. Aircraft Weight and Center of Gravity. Weight (kg/lbs) c.g. (Sta) (cm/in)

a. Empty aircraft Basic Weight 37,478/17,000

c.g. 762/300

b. Ferry mission configuration Basic Weight 41,887/19,000

c.g. 508/200

c. Combat mission configuration Basic Weight 46,297/21,000

c.g. 635/250

d. Operating weight and c.g. Basic Weight 44,092/20,000

c.g. 254/100

e. Ferry mission gross takeoff weight. 46,297/21,000

f. Combat mission gross takeoff weight. 55,116/25,000

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5. Aircraft Subsystems and Associated Equipment.

a. Major component weight (Kg/lbs)

<u>Nomenclature</u>	<u>Model</u>	<u>SN</u>	<u>Weight</u>
<u>Chaff Dispenser</u>	<u>M-130</u>	<u>48</u>	<u>4.5/10</u>
_____	_____	_____	_____

b. Major component dimensions (cm/in) (If component is of a complex shape, provide drawing showing adequate dimensions.)

<u>Nomenclature</u>	<u>Model</u>	<u>SN</u>	<u>Length</u>	<u>Width</u>	<u>Height</u>
<u>Chaff Dispenser</u>	<u>M-130</u>	<u>48</u>	<u>31/12</u>	<u>15/6</u>	<u>8/3</u>
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

c. Major component volume (cm³/in³)

<u>Nomenclature</u>	<u>Model</u>	<u>S/N</u>	<u>Volume</u>
<u>Chaff Dispenser</u>	<u>M-130</u>	<u>48</u>	<u>3540/216</u>
_____	_____	_____	_____
_____	_____	_____	_____

d. Photographs - complete Yes/No

6. Electronic, Avionics, and Communication Equipment.

a. Equipment dimensions (cm/in)

<u>Nomenclature</u>	<u>Model</u>	<u>SN</u>	<u>Length</u>	<u>Width</u>	<u>Height</u>
<u>M-130</u>	<u>V2</u>	<u>28</u>	<u>30.5/12</u>	<u>20.3/8</u>	<u>7.6/3</u>
_____	_____	_____	_____	_____	_____

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b. Equipment dimensions including attachments (cm/inches).

<u>Nomenclature</u>	<u>Model</u>	<u>SN</u>	<u>Length</u>	<u>Width</u>	<u>Height</u>
<u>M-130</u>	<u>V2</u>	<u>28</u>	<u>30.5/12</u>	<u>20.3/8</u>	<u>7.6/3</u>
_____	_____	_____	_____	_____	_____

c. Equipment weight, excluding cables and connectors (kg/lbs).

<u>Nomenclature</u>	<u>Model</u>	<u>SN</u>	<u>Weight</u>
<u>M-130</u>	<u>V2</u>	<u>28</u>	<u>13.6/30</u>

d. Photographs - complete Yes/No

7. Ground Support Equipment.

a. Vehicles and carts.

- (1) Maximum length (cm/in). 243.8/96.0
- (2) Maximum width (cm/in). 152.4/60.0
- (3) Height (cm/in). 152.4/60.0
- (4) Wheel-base (cm/in). 243.8/96.0
Wheel-track 152.4/60.0
- (5) Control storage and maintenance
access door(s) dimensions (cm/in). 121.9/48.0
- (6) Minimum ground clearance (level
surface) (cm/in). 20.3/8.0

(7) Cables and hoses length (m/ft or cm/in)

<u>Nomenclature</u>	<u>Part Number</u>	<u>Length</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

(8) Tow-bar type, length (cm/in)

<u>Type</u>	<u>Length</u>
_____	<u>/</u>

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(9) Pintle height, if applicable (cm/in). 50.8/20

(10) Compartment dimensions (m/ft) (The compartments illustrated are examples. List only actual compartments when designing a data sheet.)

<u>Compartment</u>	<u>Length</u>	<u>Width</u>	<u>Height</u>
<u>Storage</u>	<u>1.2/4</u>	<u>1.5/5</u>	<u>1.8/6</u>
<u>Cargo</u>	<u>1.8/6</u>	<u>1.2/4</u>	<u>1.5/5</u>
<u>Equipment</u>	<u>2.1/7</u>	<u>1.8/6</u>	<u>1.8/6</u>
<u>Engine</u>	<u>1.8/6</u>	<u>1.5/5</u>	<u>1.2/4</u>
<u>Generator</u>	<u>1.5/5</u>	<u>1.2/4</u>	<u>0.9/3</u>

(11) Tank Capacities (liter/gal)

<u>Tank</u>	<u>Capacity</u>
<u>Oil</u>	<u>3.8/1.0</u>
<u>Fuel</u>	<u>18.9/5.0</u>
<u> </u>	<u> </u>
<u> </u>	<u> </u>

(12) Empty weight (kg/lbs). 123.8/273

(13) Fueled weight, as applicable (kg/lbs). 142.8/313

(14) Maximum gross weight (combat or mission task configuration) (kg/lbs). 158.8/350

(15) Center of gravity (cm/in)

<u>X</u>	<u>Y</u>	<u>Z</u>
<u>121.9/48</u>	<u>50.8/20</u>	<u>61.0/24</u>

b. Test sets.

(1) Three view drawing of the equipment prepared for service and configured for storage (m-cm/ft-in). Drawing complete.

Yes/No

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(2) Equipment weight (kg/lbs).

Prepared for service.

2.3/5

Configured for storage.

1.4/3

8. Personnel Equipment.

a. Clothing (protective and flight).

(1) Breast dimensions (cm/in).

91.4/36

(2) Sleeve length (cm/in).

40.6/16

(3) Leg inseam length (cm/in).

63.5/25

(4) Waist (cm/in).

63.5/25

(5) Weight (grams/ounces).

1.8/4

b. Helmets.

(1) Helmet external dimensions. Drawing provided.

Yes/No

(2) Helmet chin strap length (cm/in).

20.3/8

(3) Communication cable length (cm/in).

30.5/12

(4) Types of electrical connectors used.

(5) Visor dimensions (cm/in).

20.3/8

(6) Maximum and minimum size obtainable with various pads available (from 5th to 99th percentile).

Max _____ Min _____

(7) Helmet weight with and without accessories (kg/lbs).

4.5/10

9. Ammunition.

a. External geometry (cm/in)

30.5/13

Three-view drawing provided.
(length, diameter(s), nose-shape) Dimensions provided (cm/in).

b. Weight (Kg/lbs)

11.4/25

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APPENDIX C

REFERENCES

REQUIRED REFERENCES

1. MIL-STD-129L, Marking for Shipment and Storage, 15 October 1990.
2. MIL-STD-130G, Identification Marking of U.S. Military Property, 11 October 1988.
3. FED-STD-751A, Stitches, Seams, and Stitching, 25 January 1965; Amendment 1, 23 June 1977; Change Notice 1, 21 November 1983.
4. MIL-STD-1472D, Human Engineering Design Criteria for Military Systems, Equipment and Facilities, 14 March 1989.

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- a. TOP 7-2-087, Clothing (Aviation), 19 March 1971.
- b. TOP 7-3-087, Clothing (Aviation), 23 December 1970.
- c. TOP 7-3-095, Survival Equipment (Aviation), 13 June 1986.
- d. TOP 7-3-509, Compatibility, Related Equipment (Aviation Materiel), 19 May 1978.
- e. TOP 7-3-529, Ingress, Emergency Egress, and Emergency Evacuation Testing of Aircraft, Aircraft Systems, and Personnel Equipment, pending publication.
- f. TOP 7-3-085, Helmets (Aviation), 26 April 1971.